

RESISTANCE TO DISRUPTION IN A CLASSROOM SETTING

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Substantial experimental evidence indicates that behavior reinforced on a denser schedule is more resistant to disruption than is behavior reinforced on a thinner schedule. The present experiment studied resistance to disruption in a natural educational environment. Responding during familiar activities was reinforced on a multiple variable-interval (VI) 7-s VI 30-s schedule for 6 participants with developmental disabilities. Resistance to disruption was measured by presenting a distracting item. Response rates in the disruption components were compared to within-session response rates in prior baseline components. Results were consistent with the predictions of behavioral momentum theory for 5 of 6 participants.

Key words: behavioral momentum, relative reinforcement density, behavioral persistence, multiple schedules, developmental disabilities

Reinforcement schedule thinning is a commonly used tactic for maintaining acquired skills. However, basic research on behavioral momentum suggests that this strategy may be counterproductive, particularly if schedule thinning occurs in a distracting classroom environment (Nevin, 1974, 1992; Nevin & Grace,

2000). This study examined the strength of task-related behavior under differing schedules of reinforcement in the presence of commonly occurring distracting stimuli using the behavioral momentum metaphor. The behavioral momentum metaphor borrows its terminology from classical physics. In physics, the momentum of an object is the product of its velocity and mass. If an external force is applied to the object, the greater the mass, the greater the resistance to change or disruption. In behavioral momentum, rate of responding is analogous to velocity and is largely determined by the schedule of reinforcement (the response–reinforcer relation). The characteristic rate or magnitude of obtained reinforcement in the situation (the stimulus–reinforcer relation) determines the behavioral analogue of mass (Nevin, 1974).

Studies with nonhuman subjects have measured relative resistance to change using a multiple-schedule arrangement with two components with different rates of reinforcement. Relative resistance to change was determined by introducing disrupters such as extinction or

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Table 1
Experimental Details

Participant, age, diagnosis, PPVT MAE ^a	VI 7-s task	VI 30-s task	Reinforcer	Disrupter	Number of baseline sessions
Ben, 13, ADHD and OCD ^b , 12.3	spelling	math	tokens	laptop computer with racing game, computer magazine	18
Cody, 12, autism, 8.9	math	spelling	tokens	toy activity set	12
Paul, 11, autism, <1.75	beads	puzzles	candy	sing-along video	31
Jon, 5, PDD ^c , <1.75	beads	blocks	onion rings, chips	cartoons DVD	17
Ryan, 4, autism, 5.6	blocks	puzzles	pretzels, raisins	cartoons DVD	20
Noah, 8, autism, <1.75	blocks	puzzles	pretzels	push-button musical books	16

^a Peabody Picture Vocabulary Test–Revised mental age-equivalent score; score of <1.75 years indicates failure to achieve the basal score.

^b Attention deficit hyperactivity disorder and obsessive compulsive disorder.

^c Pervasive developmental disorder.

prefeeding and measuring disruption in responding as a proportion of baseline response rate (e.g., Nevin, Mandell, & Atak, 1983). Responding in the more densely reinforced component was generally more resistant to disruption (see Nevin & Grace, 2000, for a review).

The majority of studies with human subjects with developmental disabilities have examined behavioral momentum effects using computer-based tasks in laboratory settings (e.g., Dube, McIlvane, Mazzitelli, & McNamara, 2003). In contrast, Mace et al. (1990) examined behavioral momentum with two adults with intellectual disabilities in the participants' group home. The responses were sorting plastic dinnerware, and the disrupter was a video. Results showed that behavior exposed to a higher rate of reinforcement (i.e., a richer schedule of reinforcement) was more resistant to disruption.

The present study replicated and extended the findings of Mace et al. (1990). Subjects were children with developmental disabilities, and the settings were their special education classrooms. The behavior measured was responding to regularly scheduled academic tasks or structured leisure activities. The reinforcers were those ordinarily used in the classroom to teach or maintain such behavior (e.g., tokens), and the disrupters were potentially distracting

objects or events that were also part of the subjects' typical educational environment.

METHOD

Participants

Six boys enrolled in special education programs participated in the study. All participants were selected based on their ability to complete academic or simple leisure tasks and parental consent for their participation. Table 1 shows participants' ages, diagnoses (from school records), and Peabody Picture Vocabulary Test–Revised mental age-equivalent scores. Ben, Cody, Paul, Jon, and Ryan attended a day school for children with autism and developmental disabilities, and Noah attended a behavioral residential program.

Settings and Materials

All sessions took place at the desk or table where the student usually worked. Ben and Cody sat at a table in their classroom, and the academic task materials were spelling and math worksheets copied on blue or white paper. Paul, Jon, Ryan, and Noah regularly received individual instruction in small areas (approximately 1.5 m by 1.5 m) separated from the common area of the classroom with room dividers on three sides. A camcorder mounted above the

student's desk recorded each session. Leisure activity materials included 8- and 24-piece puzzles, 1-in. wooden beads with string, and 1- to 2-in. interlocking blocks. Disrupter stimuli were chosen individually for each participant based on teacher reports of preference among items that could be manipulated while one hand was kept free for task engagement (see Table 1).

The experimenter used a handheld computer to run implement a multiple variable-interval (VI) VI schedule. The computer program cued the experimenter through an earpiece as to when to begin each component of the multiple schedule, when a reinforcer should be delivered following the next response, and when to end each component of the session.

Reinforcers were the same as those used for participants' regular instruction. Ben and Cody received tokens that were exchangeable for a break with a toy or computer game after the session. Paul, Jon, Ryan, and Noah received preferred food items; these items were determined by recent preference assessments conducted either by the student's teacher or by the experimenter. Reinforcers for each participant are listed in Table 1.

Response Measurement and Reliability

The dependent variable was the rate of task-related responding in each component of the multiple schedule. For Ben and Cody, a response was defined as making a written mark on a page. The number of responses per component was determined after sessions by counting letters, numerals, lines, punctuation, and any marks still visible on the worksheet after erasing. Incorrect answers were also counted as responses. For Paul, Jon, Ryan, and Noah, reinforcement was delivered for specific responses that indicated task-appropriate engagement with the activity. *Puzzle building* included picking up a puzzle piece from the desk, touching it to the board, moving a piece already on the board, or placing a piece anywhere on the desk or puzzle board. *Block*

building included picking up a block, attaching a block, or detaching a block. *Bead stringing* included picking up a bead, touching the tip of the string to a bead, or pulling the string through a bead. For these four participants, the videotaped sessions were downloaded to a computer and coded for number of responses per component using the Video Frame Coder software program.

Interobserver agreement was calculated for 100% of test sessions by comparing the response counts of two independent scorers. Interobserver agreement was determined by dividing the number of agreements by agreements plus disagreements and multiplying by 100%. Mean interobserver agreement for all participants was 96% (range for individual sessions, 80% to 100%).

Procedure

During all sessions, the experimenter verbally prompted Ben and Cody with the phrase "It's time to work" if no response occurred for 5 s. Paul, Ryan, and Noah were prompted to respond if no response occurred for 10 s, first verbally ("It's time to work on —") and then with a light physical prompt repeated if necessary every 5 s. Prompting rarely occurred for these participants. For Jon, who paused more often than the other participants, if no response occurred for 5 s, the experimenter used full manual guidance to prompt him to respond, and the prompt was repeated at 5-s intervals if he did not respond independently. His prompted responses were never followed by reinforcers during the sessions and were not included in response totals.

Baseline sessions. Sessions included alternating components with two tasks, with a VI 7-s schedule for one task and a VI 30-s schedule for the other task (Table 1). The task-schedule pairings remained the same throughout all sessions for each participant. The VI 7-s schedule included the following values: 2, 3, 4, 5, 7, 9, 10, 11, and 12 s; the VI 30-s schedule included 10, 15, 20, 25, 30, 35, 40, 45, and

50 s. Each schedule value was programmed in random order, with the restriction that every value occurred before any was repeated. The two tasks or activities alternated within sessions, and the order in which they appeared alternated across sessions. Each component was 90 s long, followed by a 20-s intercomponent interval. Ben's and Cody's sessions consisted of eight components, and the remaining participants' sessions consisted of six components. The baseline phase continued for a minimum of 12 sessions and until response rates for both activities were judged to be stable by visual inspection. The initial baseline phase averaged 19 sessions across participants (Table 1).

Test sessions. Following the initial series of baseline sessions, a multielement design that alternated baseline and test sessions was implemented for each participant (similar to Dube *et al.*, 2003). The structure of test sessions was the same as for baseline sessions, with the exception that during test sessions a distracting item (*i.e.*, disrupter stimulus, see Table 1) was introduced during the fifth and sixth components. A second experimenter sat next to Ben and Cody and engaged with the item so that the participant could easily watch. For the other participants, the distracting item was place on the table. Responding to the tasks was reinforced on the designated schedule during distracter components just as it was during baseline components. The order of components within test sessions alternated across successive test sessions. Ben, the first participant in the experiment, received six test sessions. All other participants received a minimum of six test sessions, and testing continued until responding was consistently higher for one task across at least five of six consecutive sessions or until a maximum of 10 test sessions were conducted.

RESULTS AND DISCUSSION

The data of interest are the rate of task responding during test components, expressed as a proportion of average response rates in the

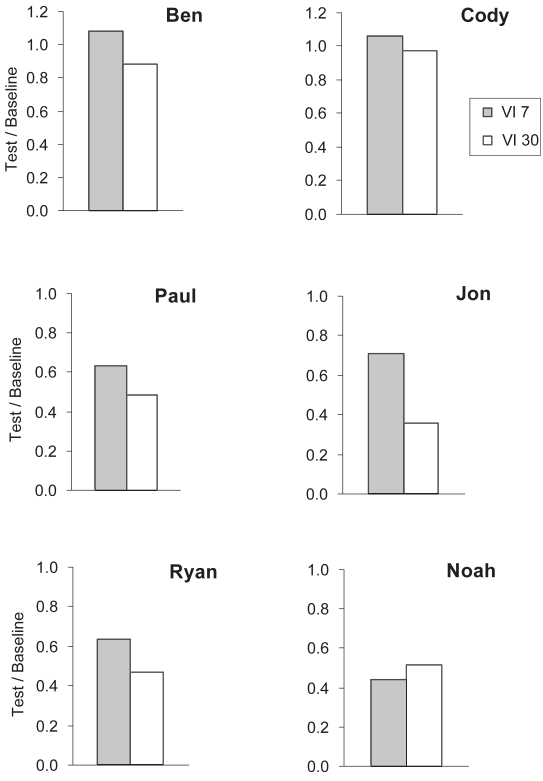


Figure 1. Mean response rate as a proportion of baseline response rate for the last six test sessions for all participants.

prior baseline components within the same session. A test–baseline response ratio for each task was calculated by dividing the response rate during the test component by the response rate in the first two baseline components for the same task in the same test session. The mean proportional response rate for each participant, from the final six test sessions, is shown in Figure 1. Individual session data, which are consistent with the overall means, are available from the first author.

For five of six participants, resistance to distraction was greater for the task associated with the richer schedule of reinforcement, although the effect was small for Cody. For the sixth participant (Noah), resistance to distraction was slightly greater for the task associated with the thinner schedule. These results, along with those of Mace *et al.* (1990), indicate that the predictions of behavioral

momentum theory may be applicable to clinical settings. Notably, the settings, instructional or leisure materials, responses, reinforcers, and distracters all occurred in the participants' everyday environments. Thus, ongoing relative reinforcer rates may affect behavioral persistence in the absence of the relatively high level of control found in the laboratory. Although schedules of reinforcement are typically thinned to maintain responding, these results suggest that behavior will be more likely to be maintained in the presence of common distracters if the behavior is reinforced on a denser schedule. Additional research is needed to reconcile the benefits and limitations of schedule thinning.

One distinction between the current study and Mace et al. (1990) concerns response topography. The task in Mace et al. (sorting plastic dinnerware) was the same in both rich and lean components. In the present study, the academic tasks differed in subject content for Ben and Cody, and the leisure activities differed in response requirements for the remaining participants. (Note that response rates were never compared across activities; only within-task proportional measures of response disruption were compared.) Although the participants were familiar with and had previously mastered all of the tasks, it is possible that the two tasks were not of equivalent response effort for some participants. If so, the results may reflect an

interaction between effort and reinforcer rate. This possibility is a topic for future research, along with other variables that influence resistance to change in natural settings (e.g., Ahearn, Clark, Gardenier, Chung, & Dube, 2003).

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